Research News
Issue 9,   September 2014

Welcome to DWI Research News

This newsletter is intended to provide a brief summary of recent outputs of the Water Quality and Health evidence programme. The contents section to the right lists the projects covered, and provides useful links to our evidence plan, which lays out the aims and objectives of our research programme, and a quick link to Defra's E-tendering site to register your interest in our future competitions.

Recently published DWI research

Assessing the likelihood of selected veterinary medicines reaching drinking water

The results from both this study and its predecessor shows that exposure to veterinary medicines via drinking water does not pose a significant risk to public health.

An earlier desk based study(PDF 1.65MB) used a number of worst case assumptions to confirm safe levels of intake via drinking water for most veterinary medicines, and identified ten compounds where intake may be close to or above the acceptable daily intake (ADI). ADAS undertook this follow up project to further assess the potential risk posed by these ten compounds by generating more realistic estimates of human exposure through drinking water sources. This was done by refining: active substance property information; veterinary medicine usage and loads applied to agricultural land; and simulation modelling, by employing a catchment-based simulation modelling approach.

The modelled concentrations were typically a factor of several hundred to several tens of thousands below the toxicological thresholds. There are also additional factors which provide further margins of safety.

Based on the results of this study it is concluded that the ten compounds investigated are not expected to impact on drinking water quality under realistic worst case conditions in real world catchments.

The full report is available (PDF 1.85MB)

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DWI's Evidence Plan (PDF 90KB)

Defra's E-tendering site

Speciation of Manganese in Drinking Water

This project, undertaken by WRc was set up to review the recent data on the potential neurotoxicity of manganese (Mn) relating to oral intake via drinking water. Four seasonal monitoring surveys were conducted on final drinking water at 20 sites in England and Wales that had been identified as being at potential risk of high Mn concentrations. Eighteen of these were public supplies and a further two were private supplies.

The findings show that the human epidemiological studies, particularly on children, are suggestive of a possible effect on intellectual and cognitive development. However, the types of studies conducted were not the most appropriate for measuring any longer-term effects such as those which may occur after accumulation of Mn in the brain. The studies also do not provide an accurate estimation of exposure via drinking water alone, and the detection of Mn in the body. Therefore, the experimental animal and human studies do not provide conclusive evidence that exposure to Mn in drinking water causes adverse neurological effects in humans.

In the recent Canadian studies, populations were exposed to borehole drinking water with variable levels of naturally high Mn, mainly in the bioavailable Mn(II) form (95%). In the other epidemiological studies in Bangladesh and China where drinking water Mn was measured, the concentrations were very high with maximum concentrations up to 6000µg/l but the Mn speciation was unknown.

A monitoring survey was conducted in England and Wales to ascertain whether the final drinking waters were similar to those in the Canadian study. The survey measured total and soluble manganese, soluble Mn was reported as Mn (II) and Mn (IV) concentration was calculated as the difference between the total and soluble concentrations. It was found that the Canadian studies do not represent the typical situation in the public supplies of England and Wales. However two private borehole supplies were similar to the supplies in the Canadian study. British Geological Survey data indicates that these boreholes are in a geological area which may have high deposits of Mn,. The report suggests that a review existing private water supply data may be wise before deciding whether further monitoring would be warranted .

Further studies are underway in Canada to investigate any possible association between manganese in drinking water and intellectual development.

The full report is available for download (PDF 2.51MB)

Health Risk Reductions

This was a jointly funded project with the Water Research Foundation (WRF) and American Water Works Association (AWWA). It's aim was to develop a tool to help water utilities prioritise health risk reduction strategies for contaminants of concern and communicate these relative health impacts to customers and policy makers.

This research team evaluated various cumulative risk methodologies applicable for drinking water. Ultimately, a simple approach was developed to combine exposure, toxicity, and disease severity in a Relative Health Indicator (RHI) metric within a spreadsheet-based model. The resultant model was applied to ten utilities in the US.

The full findings of the research is available from WRF. The results show that this research provides tools that could be used to prioritise risk from drinking water. Whilst the example case studies are from the US, the approach could be applied to England and Wales. Findings confirm the importance of microbial risks and show the reduction in drinking water risk over time as treatment has been installed.

Online monitor performance

Current guidance for compliance monitoring allows the use of online monitors for data collection. However, there has been little uptake of this by UK water companies. The DWI wanted to understand whether more flexible guidance would allow water companies to make greater use of on line monitors to minimise the cost of monitoring without prejudicing effective regulation. WRc undertook this project to assess the scope for providing simpler guidelines to encourage wider take-up of this option without risks to data reliability and compliance regulations.

This project has found that although current guidance permits the use of online monitoring for compliance reporting, companies are still using manual collection of samples followed by laboratory analysis for all parameters.

Reasons for this are a lack of economic benefit and difficulties with meeting parts of the guidance relating to the difference of means and achieving a 95% confidence interval between online and manual samples.

It is not proposed to change the guidance at the current time.

Risks from Personal Care Products (PCPs) and Domestic Cleaning products (DCPs)

Examination of risks posed by PCPs in other countries have concluded that they do not pose a significant risk to consumers who may be exposed via drinking water. The DWI felt there was a need to better understand the risks to drinking water supplies in England and Wales.

WRc undertook a systematic risk assessment of approximately 690 chemicals, with 33 identified as having a high potential for reaching drinking water supplies. Out of the 33 prioritised chemicals, the models indicated that exposure via drinking water and bathing was significantly lower for 19 chemicals that would be anticipated through their intended use. Data were lacking on 4 of these compounds, and therefore a comparison of exposure via these routes could not be conducted. Ten chemicals were predicted to produce maximum exposure through drinking water and bathing than would be close to or greater than anticipated through their intended use. When a more

realistic estimate of environmental dilution was used, this figure dropped by three to seven. The refined exposure ratios were relatively small for all three compounds.

The project gave generally reassuring results, and concluded that for most of the PCPs exposure from drinking water would be lower than from normal use. The DWI will consider whether any further research is justified in this area.

Full report can be downloaded (PDF 1.35MB)

Toxicological evaluation for pharmaceuticals in drinking water

This project followed up on previous desk and monitoring studies on pharmaceuticals, and was undertaken to compare maximum intakes of the five pharmaceuticals detected in drinking water with toxicological end points, such as acceptable daily intakes (ADIs) to provide a health risk assessment.

This project was undertaken by Ricardo AEA and their findings showed the intakes of all pharmaceuticals for all receptors (adults, children and infants) were all below the calculated ADIs and the hazard quotient were all <1. Moreover, the margin of exposures for all chemicals indicated it would be unlikely that they would be of concern.

Based on the levels of specific pharmaceuticals in drinking water samples reported by Boxall et al. (2011),

using default exposure parameters, and toxicological endpoints as a point of departure, then the levels of these pharmaceuticals measured in drinking water are not anticipated to pose an appreciable risk to public health.

The [full report](#) can be downloaded (PDF 1.07MB)

Raw Water Monitoring Data

ESI Ltd undertook this study for DWI, to validate and analyse the raw water monitoring data for years 2009 through 2011 inclusive, and to report on trends and other observations. This project would inform the DWI's risk based approach for audit, water companies risk assessment requirements, identify adverse water quality hazards, and differences with company practice. This will support the Inspector's role in ensuring water supplies remain safe and any new risks to supplies are identified.

The report showed that most water companies provided data to assess general water quality parameters such as turbidity, nitrogen species, hydrogen ion (pH), colour, metals etc. However, there were significant variations between companies, with some companies not providing any data for some parameters. Some companies may need to review their analytical methods to ensure that methods are used with an appropriate level of detection.

Suggestions have also been made regarding how future data is collected by the companies and subsequently stored by DWI.. DWI will investigate these matters further.

A [summary of the report](#) is available (PDF 52KB)

Viruses in raw and partially treated water : targeted monitoring using the latest methods

The determination of virus removal efficiency within a water treatment plant is dependent on the ability to reliably detect and enumerate the viruses. Removal is generally effected by physical association of virus with other particles, a process which is enhanced by the addition of coagulants and certain salts. Particulate matter in the form of floc containing viruses are then removed during settlement and filtration.

Recent developments in analytical methods to detect and enumerate specific enteric viruses has allowed accurate and focussed investigations to determine levels of viruses in environmental water samples. The Inspectorate commissioned this work (undertaken by Hyder Consulting (UK) Ltd) to understand the prevalence of these viruses in raw water and associated removal during treatment. This study specifically looks at Norovirus (NV) and Adenovirus (AdV) and used a targeted monitoring exercise at a number of treatment

works to determine concentrations of the viruses and their significance. A range of other chemical and microbiological samples were analysed simultaneously to the virus samples. A key outcome of this project was to develop existing analytical methods for viruses for routine use in laboratories.

The study used water samples taken from multiple points at four distinctly geographically different water treatment works with varying catchments and treatment stages. The monitoring was carried out over a nine month period (June 2011- March 2012 inclusive). The laboratory stage of the project then focussed on the isolation, detection and quantification of candidate viruses Norovirus and Adenovirus by quantitative polymerase chain reaction (qPCR) and reverse-transcription qPCR (RT-qPCR) technology.

All of the methods used are considered robust and reliable and could reasonably be transferred to competent water utility laboratories for routine use.

AdV was present in 74% of raw water samples taken throughout the year and, whilst the water treatment process reduced the level of AdV by between 2 and 4 orders of magnitude, the virus appeared to persist through to the pre-chlorination stages. Around 20% of all pre-chlorination (final stage) samples were AdV positive although none of the isolates proved to be infective when assessed by integrated cell culture PCR (ICC-PCR).

Therefore a multi barrier treatment process can effectively remove Adenovirus. The largest removal of AdV occurred at the early stages of conventional treatment (post clarification).

NV was generally not detected in raw waters except during the winter months, December-March, when 94% of the raw water samples were positive. In contrast to AdV, there was apparently no significant removal effect of treatment on the level of NV.

However, the levels of NV in raw waters were often below the limit of detection, and the demonstration of a significant reduction in numbers was impossible. Therefore it is not feasibly possible to make robust conclusions regarding the removal of Norovirus using data from this study alone.

The full report is available (PDF 644KB)

Enhancing the value of molecular methods to the water industry: an E. coli case study

The standard methodology for total coliform and E. coli testing by water utilities is culture using agar or broth media that often require incubation for 18–24 hours. Increasingly, molecular analytical techniques have become well established methods for detecting the presence of microbes in clinical, environmental and food samples. However, the success of using molecular techniques has not been

realised in the regulatory drinking water setting, even though polymerase chain reaction techniques offer the means to rapidly monitor and quantify indicator, established and emerging pathogens. The absence of standardised methods for the molecular analysis of water samples and evidence based guidance are amongst the reasons why molecular techniques haven't replaced culture methods; which are still considered the gold standard. In addition, there is a multitude of methods, supplies, and equipment and no obvious reference for comparing methods, optimising them or establishing performance and for troubleshooting when faced with unexpected results.

This research, co-funded by WRF and DWI, uses E. coli as the reference organism to compare regulatory accepted culture-based methods with promising molecular techniques whose performance will be assessed using current regulatory requirements.

The study found that the molecular methods developed in this project have the potential to be useful for detecting the presence of viable E. coli in drinking water samples within an 8hr time frame and for confirming the results of culture based tests. However, feedback from collaborators indicated the methods were limited because of the time samples arrived at the laboratory and the complexity of the method when compared to traditional culture methods. Furthermore development of molecular techniques is

required before the data can be used for regulatory purposes.

The executive summary (PDF 649KB) is available on our website, and the full report from the WRF website.

Brass fittings – a source of lead in drinking water?

The DWI has contributed to an UKWIR study on lead from brass fittings. As brass fittings used in water supply may typically contain up to 5% lead to aid the machinability of the brass, the aims of the project was to : assess the contribution of brass fittings to concentrations of lead in drinking water; inform the development of national and local strategies to reduce lead levels in drinking water; and to provide evidence/information to inform a discussion about the suitability of the present UK norms for the lead content of brass fittings. The study reviewed the literature and conducted surveys of water companies and fittings manufacturers.

An initial phase of the study used laboratory stagnation tests to identify makes and types of fittings that had the potential to contribute lead to drinking water.

A second phase used test rigs deployed at water treatment works to measure release of lead in a more realistic scenario. The tests included both hard and soft water sites and at each site both phosphate dosed and non-phosphate dosed supplies were tested.

Low lead fitting were tested alongside conventional fittings identified in the stagnation tests

The summary of the report (PDF 258KB) and its findings is available for download.

Concentrations of lead in drinking water have been reduced significantly over recent years. This has largely been the result of phosphate dosing but lead pipe replacements will also have had an effect. This study confirms that brass fittings have the potential to make a significant contribution to the concentration of lead in drinking water, particularly where phosphate dosing is not practised.